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Development goal of 30 GW for China's biomass power generation: Will it be achieved?

Zhao Xingang*, Tan Zhongfu, Liu Pingkuo

School of Economics and Management, North China Electric Power University, Beijing 102206, China

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ABSTRACT

China currently is engaged in resolving many issues, which involve increasing peasants' income, protecting environment and adjusting energy structure, which are able to be solved by developing the biomass power generation industry. This paper focuses on the development goal of 30 GW for China's biomass power generation, summarizes the industrial situation and policy environment, discusses the possibility of achieving the development goal, and introduces the way to achieve the goal. We draw the following conclusions: (1) there are still some obstacles to be overcome, such as the insufficient raw material supply, the low feed-in tariff, and the poor ability of technical research; (2) according to China's current industrial situation, it is possible to achieve the development goal; (3) China's policy tools is able to guarantee the industry development goal. At last, we offer several policy recommendations for adjusting the feed-in tariff and completing the Tradable Green Certificate system.

Contents

* Corresponding author. Tel.: +0086 10 51963571: fax: +86 130 4115 7885.
E-mail address: rainman319@sina.com (Z. Xingang).

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1. Introduction

1.1. Background

Based on the medium- to long-term development planning of renewable energy, Chinese Central People's Government has proposed the development goals for biomass power generation: by 2010, its installed capacity would be 5.5 GW (equivalent to generating capacity of 27.28 billion kWh); by 2020, its installed capacity will be 30 GW (equivalent to generating capacity of 148.8 billion kWh). According to the "12*th Five-Year Plan*" of renewable energy, the development goal of biomass power generation capacity has been determined, to be 13 GW during the next 5 years (2010–2015). Based on the target of the planning, biomass power generation is more popular than photovoltaic power generation in China [1,2].

In April 2011, the Ministry of Finance People's Republic of China (MFPRC), the National Energy Bureau (NEB) and the Ministry of agriculture of the People's Republic of China (MAPRC) together issued the "*Interim Measures on assistance fund management of green energy demonstration counties*" [3]. According to the *Interim Measures*, all of the "*green energy demonstration counties*" will be subsidized with a total of $ 3.9 million, mainly for biogas generation, biomass power generation projects and so on. According to the goal of "*building* 200 *green energy demonstration counties by* 2015", biomass industry will receive a huge investment of more than $ 3.1 billion. So, biomass energy industry will get an opportunity to accelerate its own development [5,9].

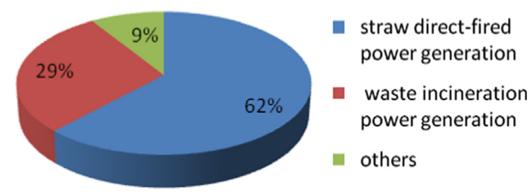


Fig. 2. Composition and proportion of China's biomass power generation 2009.

Table 1
The installed capacity of biomass power generation (MW).
Source: Report on China renewable energy utilization analysis 2009–2012.

Year	Bagasse power	Straw direct-fired power	Gasification power	Rice husks power	Waste incineration power	Land fill gas power	Biogas power	Total
1985	600							600
1990	800				18			818
1995	800				50			850
2000	1000				100			1100
2001	1000				120			1120
2002	1500			2	150			1652
2003	1700			15	180			1895
2004	1700		1	25	210			1936
2005	1700		1	40	300	5	30	2071
2006	1700	25	6	42	360	13	86	2219
2007	1700	367	10	45	462	32	125	2709
2008	1700	592	18	50	603	45	173	3136

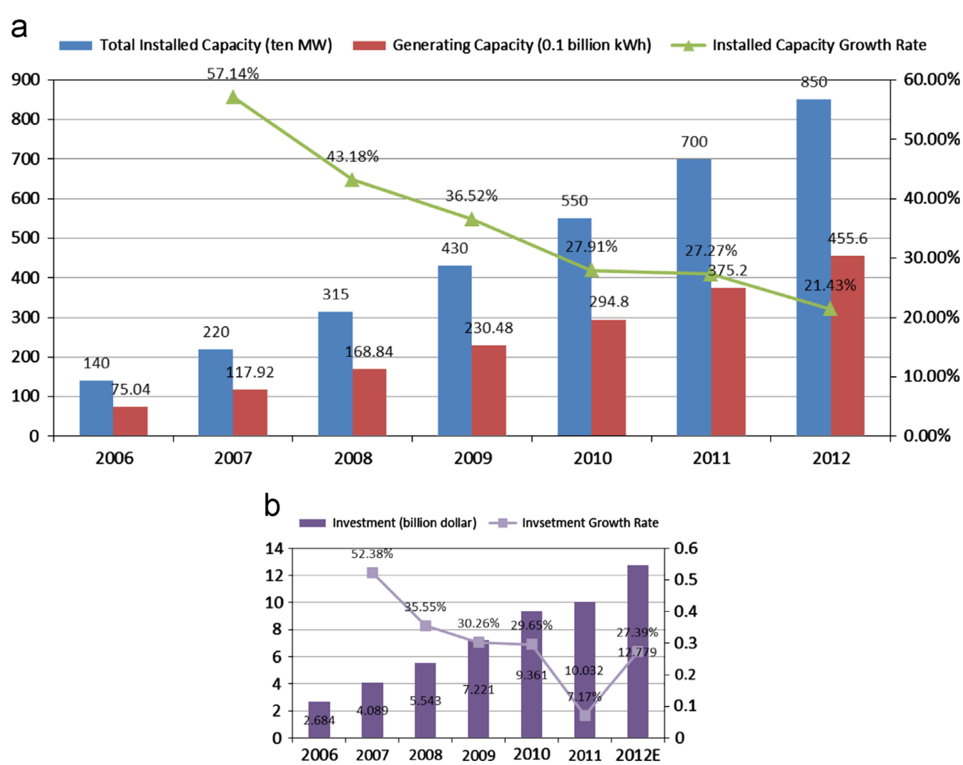


Fig. 1. (a) Scale changing trends of China biomass power generation industry 2006–2012. (b) Investment changing trends of China biomass power generation industry 2006–2012.

Table 2
Fiscal policy of biomass power generation.
Source: authors.

	Law or regulation	The subsidized enterprise	Method	Standard
January 2006	*Interim Measures on additional revenue on renewable energy tariff*	The independent power system of public renewable energy invested or constructed by the government	According to the cost situation of operation and maintenance	Subsidy = the cost of operation and maintenance – the mean selling price of local provincial power grids * the sales volume of electricity for independent power system of public renewable energy resources
January 2007	*Interim Measures on collection and allocation of renewable power surcharge*	The grid connecting of power generation projects of renewable energy resources	According to the length of line	\$0.00016/kWh when less than 50 km, \$0.00032/kWh when between 50 km and 100 km, \$0.00048/kWh when equal to and more than 100 km
November 2008	*Interim Measures on management of Fund of utilizing straw resources*	Energy-oriented enterprises using straw resources as fuel, straw gasification, straw distillation, etc.	According to comprehensive assessment	According to the types and quantities of straw consumption, the central finance provides the comprehensive subsidies according to a certain standard

1.2. Issues

Although great achievements of utilizing biomass had been made during the "11*th Five-Year Plan*" period (2006–2010), the development and utilization of bioenergy failed to achieve the desired goals. By the end of 2010, China's biomass power generation capacity was about 5.5 GW, and China will increase it to 24.5 GW in the next 10 years. According to the "12*th Five-Year Plan*" of renewable energy, biomass power generation capacity will reach 13 GW, with an increase of 160%, which means that by 2015 there will be 500–700 new biomass power plants. Is biomass power industry able to achieve the development goal of 30 GW by 2020? If so, how to achieve it?

2. Status quo

2.1. Industry situation

Because of the "*Renewable Energy Law*" and industrial policy for renewable energy, especially the mandatory accessing system and price subsidies, network-access obstacle of biomass power industry is cleared up. Therefore, China's investment in biomass power generation is increasing year by year, and various power generation projects of agriculture, forestry and waste are under construction [4]. Up to the first half of 2008, national and local Development and Reform Commission had approved and authorized over 80 biomass power projects, whose total installed capacity was 1.284 GW. By the end of 2009, China had 61 biomass power projects put into operation (20 national energy projects among them), in which the proportion of straw direct-fired power generation plants accounted for more than 80%. Biomass power generation capacity increased to 3.2 GW by 14%, ranking after the European Union, the United States and Germany [5,9].

China's biomass power generation industry has developed with a full acceleration (Table 1). From 2006 to 2011, and the total investment in biomass power generation changed from \$2.684 billion to \$10.032 billion, with a mean growth rate of more than 30%; the total of installed capacity changed from 1.4 GW in 2006 to 4.3 GW in 2009, with an Average Annual Growth Rate (AAGR) of over 30%. It was said that China's biomass power generation would reach 5.5 GW by 2010, 30 GW by 2020. In 2010, national policies for biomass power generation were still improving, the construction projects in major companies were carried out smoothly [9]. It was expected that by the end of 2010, the total installed capacity of biomass power generation would be more than 5.5 GW, the industry kept developing with a rapid growth rate (Fig. 1).

China's biomass power generation technologies mainly involve straw direct-fired power generation and waste incineration power generation [15]. Up to 2010, China's total installed capacity of straw direct-fired power generation was 2.65 GW, accounting for 62% of all biomass power generation; the total installed capacity of waste incineration power generation was 1.25 GW, accounting for 29% of all biomass power generation; other techniques, such as gasification power generation, gas generation and mixed fuel power generation, shared a small proportion of less than 10% of all biomass power generation (Fig. 2). According to the planning by National Energy Commission (NEC), China's biomass power generation installed capacity would reach 13 GW by 2015, which is 1.6 times more than that of 2010 [4].

2.2. Policy environment

2.2.1. Fiscal policy

The Chinese government has constituted a series of laws and regulations to provide a great deal of financial subsidies for biomass power generation [31]. First, according to the type and the quantity of straw consumption, the government gave comprehensive fiscal subsides for energy-oriented enterprises; second, it offered subsidies for the feed-in engineering of biomass power generation projects according to the length of the lines; third, there were also subsidies for the costs of operation and maintenance of independent power generation system of renewable energy resource[1] (Table 2).

According to *Interim Measures on Renewable Power Surcharge Collection and Allocation*, extra part of the feed-in tariff of renewable energy which is higher than the benchmark price of local desulfurization coal-fired units, the extra part of the cost of operation and maintenance of independent power generation system of public renewable energy(state invested or subsidized) which is higher than the local average selling price of provincial power grid, and the costs of integrating renewable energy generation projects into the power grid, are dealt with by levying the power users the additional renewable energy tariff [10,13].

The customers who are levied the renewable energy tariff surcharge include the users within the service scope of provincial and above provincial power grids, i.e. include the wholesale customers of provincial grid company, self-provided power plants customers and major customers who directly purchase the electricity from power plants [25].

2.2.2. Tax policy

The enterprises of biomass power generation enjoy the income tax preferential, which means that the income tax for the qualified enterprises will be exempted from the first year to the third year after they obtain the operating income and the income tax are levied by half for the next 3 years. The enterprises of rubbish

[1] Exchange Rates: \$1 = 6.26 RMB. The further occurrences will be the same.

Table 3
The comparison of tax preferential policy for biomass and rubbish power generation.
Source: authors.

	Law and regulation	Tax type	Biomass power generation	Waste incineration power generation
January 2008	*Implementation Regulations of the PRC Enterprise Income Tax Law*	Income tax	The first 3 years for duty free	The first 3 years for duty free
			The next 3 years for tax in half	The next 3 years for tax in half
December 2008	*Notice on comprehensive utilization of resources and tax policy of other products' VAT*	VAT		The instant levy and instant refund

Table 4
The price subsidy for projects of biomass power generation in China.
Source: authors.

	Law and regulation	Price standard	Price subsidy	Time limit
2006	*Pilot scheme on renewable energy price and cost management*	The benchmarking price of the desulfurized coal-fired units plus the subsidy of $0.0399/kWh in each province (autonomous region, municipality directly under the central government) in 2005.	$0.03993/kWh	For the duration of 15 years from the date of being put into operation
			Subsidy price for newly approved generation projects will be 2% more than that of the year before.	Begin from 2010
2007	*Additional subsidies for renewable energy tariff and quota trading scheme*		$0.01597/kWh for direct Straw-fired power technology	From January to September
2010	*Notice on renewable energy price subsidies and quota trading program*		$0.01597/kWh for direct Straw-fired power technology	From January to June
2012	*Notice on price policy for garbage incineration power generation from the National Development and Reform Commission*	As for garbage incineration power generation projects, each ton of garbage for grid electricity is tentatively scheduled as much as 280 kWh.	$0.10383/kWh for biomass power technology	From April 2012

Table 5
Investment and incentive policies.
source: authors.

	Law and regulation	Project	Subsidy method	Subsidy standard	Time limit
January 1999	*Notice on issues of further supporting the development of renewable energy*	Infrastructure loan for power generation projects of renewable energy which are arranged by bank	Finance discount	2%	
January 2006	*Renewable Energy Law*	Projects of poor profitability and strong public welfare	Free funding		
		The projects in the guiding catalogue for industrial development of national renewable energy or the item meeting the credit qualifications	Interest payments on loans	The rate of discount is not more than 3%	1–3 years
January 2009	*Circular Economy Promotion Law of the People's Republic of China*	Comprehensive utilization and development of straw and gas	Establishing the relevant special fund for developing circular economy		

power generation also enjoy VAT discount, which means the instant levy and instant refund (Table 3).

For the income tax, the biomass power generations enjoy the preferential policies of reduction and exemption which indicates that they get the supports on the income tax from government. However, biomass power generations do not enjoy any VAT benefit except for garbage power generations which means the instant levy and the instant refund.

2.2.3. Price subsidies

The tariff of biomass power projects is made by Chinese government and the State Council establishes the benchmark price for various regions [11]. And the electricity price covered the desulfurized coal-fired units' benchmark price of each province (autonomous regions and municipalities) in 2005 and the standard price subsidy of $0.03993/kWh.

Before the implementation of Renewable Energy Law, China did not have the price policies or economic incentives to support biomass power generation [13]. After the implementation of Renewable Energy Law, Chinese government has provided the temporary and long-term subsidy policies of electricity price for biomass power generation (Table 4). In order to support the power generation of straw direct combustion, the government has provided a temporary price subsidy. However, for the long term, the projects of biomass power generation constructed before 2010 could enjoy the fixed-price subsidy for 15 years and the price subsidy for those projects which were approved after 2010 will gradually reduce year by year [27], which indicates that the government will gradually reduce its direct price subsidy for the projects of biomass power generation.

2.2.4. Investment policy

In order to encourage enterprises to invest into biomass power generation, the Chinese government has adopted some incentive policies, such as loan discount, free financing, special fund and so on. They are shown in Table 5.

In addition to the subsidy policies above, the Tentative Measures for Revenue Allocation of Additional Electricity Price of Renewable Energy that stipulates grid enterprises should make agreement with renewable power generation enterprises, which legally obtain administrative licenses or sign the electricity purchasing contracts with power generation enterprises of renewable energy which is put into records. The electricity quantity of renewable energy projects should be bought entirely by grid enterprises within their network coverage and the grid feed-in service should be provided for renewable energy power generation in order to solve the grid feed-in issues.

The revised Renewable Energy Law (December 26, 2009) formulates that state council energy department in conjunction with the state electricity supervising department and state council financial department definite the ratio of power generation capacity of renewable energy in the total capacity of energy during the planning period [24]. And they also formulate the specific measures that the renewable energy power generation should be priority scheduled and fully taken over by grid enterprises.

2.2.5. Research and development support

Since the "6*th Five-Year-Plan*", the Chinese government arranged a certain amount of funds to support research and development of biomass energy technologies through science and technology programs, namely "863 *Program*" and "973 *Program*" [14,29]. During the period of the "9*th Five-Year-Plan*", the Ministry of Science and Technology spent about $9.3 million on renewable energy development. In the "10*th Five-Year-Plan*" period, the country totally arranged more than $1.6 million to support advanced technology development and industrialization in the field of renewable energy through science and technology programs, such as "863 *Programs*", "973 *Programs*" and other industrialization plans [21]. By now, China has invested more than $77 million in the biomass energy research in the period of the "11*th Five-Year-Plan*". During the period of the "12*th Five-Year-Plan*", the Ministry of science and technology will release the first batch of "863" projects that some enterprises will be chosen to take charge of National R & D tasks under the principle of "open, fair and justice". The total amount of startup funds for this batch of projects is about $15 million, including $2.3 million for the first phase [2].

2.3. Obstacles of development

There are so many reasons that stop the industry from developing. We take three of them into account as the main obstacles of development [26], which can be seen in Fig. 3.

2.3.1. The unreasonable distribution of biomass power plants leads to the insufficient raw material supply

In principle, biomass power plants should be arranged in the main areas of grain production with adequate straw, and not be repeatedly arranged within an area with a radius of 100 km [6,16,18]. However, for example, there are 11 biomass power plants in Jiangsu Province at present, while in the north of Jiangsu, there are 10 biomass power plants within an area with a radius of 200 km; and there are several local biomass power generation projects under construction.

From June to August in 2008, because the power plants "competitively" made purchase of raw materials, the price of the raw material increased rapidly. For example, rice husks price rose from $ 27.81/ton to $ 71.08/ton, straw price rose from $ 29.36/ton to $ 41.73/ton, bark price rose from $ 35.54/ton to $ 47.91/ton. Biomass power plants were generally running in deficit, and even some enterprises' annual losses reached 1.6 million of USD [23]. Some power plants lost money because of the rising raw material costs; while other power plants could not maintain a normal function due to lack of fuel [19].

2.3.2. The cost of power generation surpasses the feed-in tariff

Biomass power generation involves biomass harvesting, packaging, transport, storage, adaptability of combustion equipment, process management and so on [16]. Especially because the designing and manufacturing of biomass boilers are hard, the investment in imported and domestic equipment are about $ 1545.21/kWh and $ 1236.17/kWh respectively, while the investment in thermal power equipment accounts for only 50% of those. According to the cost calculation, the mean cost for biomass power plants is about $ 0.11/year. However, the feed-in tariff of biomass power generation in most provinces is $ 0.08.

According to the policy effects, we find that the subsidies for biomass power are able to make up the cost difference, biomass power plants will ignore the cost during generating [30]. So the plants do not consider the improvement of power generation technology to reduce production costs. Due to the Feed-in policy, the government bearing the additional cost of green electricity, there is no cost constraint to generate green electricity for biomass power plants.

The power plant auxiliary power of biomass power generation itself is very large, which also leads to a continuous cost increase [25]. From January to September in 2008, the mean level of the proportion of power plant auxiliary power accounted for 12.98%. Even if the proportion of power plant auxiliary power of straw direct-fired power plants falls to about 12%, it is still twice more than that of thermal power plants.

On one hand, current subsidy policies in China can neither reflect the actual investment cost of grid feed-in projects, nor account for the investment income [12]. Therefore, they cannot stimulate investment. On the other hand, limited to the installed capacity and district, local grids neither provide operation and maintenance for renewable energy power generation projects nor solve the problems of grid feed-in, which leads to obstacle of grid feed-in for biomass power generation projects [24,25].

2.3.3. The ability of technical research and development is weak

Because some problems in domestic material supply and power generation equipment slowed down the development of biomass power generation technology, biomass power generation faced technical issues at the beginning of the development. These problems came out because the government was eager to promote domestic equipment [24].

Later, there were still few achievements for biomass power generation technology in China, which was mainly caused by the

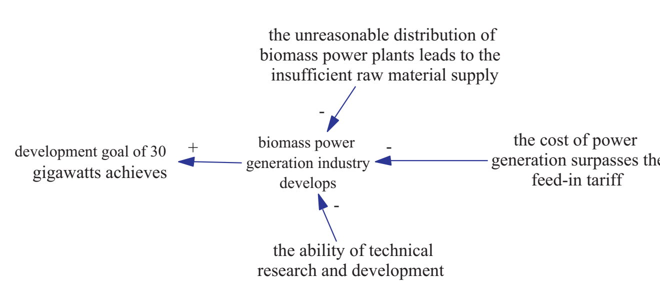


Fig. 3. Main obstacles of development.

inadequate investment in scientific research and the poor ability to develop equipment independently [12,14]. In recent decades, the investment in technology mainly aimed at small or medium biomass gasification power generation, while the straw direct-fired power generation technology was just developed by the boiler enterprises. At present, except a few biomass gasification power systems, the practical application of other biomass power generation technologies is still of less experience. Generally speaking, the types of mature biomass power generation technology are quite few [22].

3. How to achieve the development goal

3.1. Basis for development

Biomass energy is one of the most significant types of renewable energy , and it has many advantages. The development goal of 30 GW can be achieved, but it will be realistically difficult [20]. During the "11*th Five-Year Plan*" period, the government built a number of biomass power plants, with a common problem of being hard to collect biomass resources and difficult to manage the price of biomass raw materials. At present, there are a lot of potential investors who are enthusiastic for biomass power plants. It is the most important thing to plan the biomass power generation carefully and avoid unreasonable layout or distribution [8].

It is an effective way to establish "*green energy demonstration counties*" for achieving the development goal. It not only helps make full use of biomass resources and develop biomass energy industry, but also helps increase the peasants' income. One of the purposes of establishing the industry mode of "*green energy demonstration counties*" is to *provide specialized energy services in rural areas as in cities*. Establishing 200 "*green energy demonstration counties*" is not simple. The biggest problem is the implementation of the management system [12]. Over the years, China has attempted and invested a lot in rural energy construction. However, the lack of the scientific management system made it difficult to achieve the sustainable development.

There were more than 80 counties applied for the implementation of the program [15], but only over 20 counties were authorized at last. Many of the applications failed, mainly because some counties did not meet the demonstration standard and requirements, some counties did not develop the matching funds, and other counties did not have realistic plans. The program of "*green energy demonstration counties*" is to contribute to exploring a professional development mode for rural energy. Therefore, the energy demonstration projects in rural areas must be theoretically clear, procedurally legal and technically feasible. At the same time, those projects should be operated and managed in a sustainable development mode the same as the coal-fired power management.

How much is the influence of 200 "*green energy demonstration counties*" on bioenergy industry? According to the ministries of the government, the maximum subsidy from the central government for each county is up to \$3.99 million. It is estimated that the total value of central government subsidies, local supports, social capitals and the funds makes about \$16 million for the program [12,15]. And the total investment will be about \$3.19 billion in 200 "*green energy demonstration counties*". All implemented well, China's bioenergy industry will develop greatly.

3.2. Mode for development

It is important to address raw material collection problems first. Raw material collection issue is faced up with many difficulties such as scattered resources, poor transportation, low level of commercialization, large storage area, high-risk of storage. The suppliers of straw could take a delivery mode of "*peasants→person to contact (PTC)→collection stations*" to address the issues of accumulation and sales channels [16,23,28]. The demanders of straw could adopt an acquisition mode of "*independent acquisition +receiving free delivery from peasants+intermediaries delivery*" to solve the high cost and the dispersed resources. As to the price of acquisition, in the early period of industrial development, it can refer to China's coal prices and the government guiding price; when industry developing, the transaction pricing will rely more on the market. To guarantee the long-term stability of sustainable development, we must tap new ideas to develop new types of fuel, to use cheap local resources, and to promote biomass power industry toward a virtuous circle [7].

Moreover, it is necessary and positive to take full advantage of the opportunity to promote the CDM (Clean Development Mechanism) for biomass power industry. Biomass power generation industry chain needs to be improved, not only by the guidance of market mechanism but also the macro-control of the government [17]. Large-scale biomass power generation projects, not only meet all the conditions of CDM regulations, but also aid the needs of sustainable development. As the CDM helps increase the economic competitiveness of renewable energy industry, sweep away the barriers in China's rural areas for promotion and create the conditions to accelerate the promotion, biomass power projects are facing an unprecedented opportunity for development [18].

3.3. Policies for development

There are two directions for the adjustment (or reform) of industrial policy [26] (Fig. 4). One direction is to adjust the existed feed-in policy; another direction is to try an institutional change, for example, the implementation of the Renewable Portfolio Standards (RPS).

3.3.1. Adjusting the existing policy of feed-in tariff

Government will adjust electricity price of biomass power generation properly to the principal of "ensuring farmers' benefit and the basic survival ability of biomass power generation industry" [23]. First, by referring to the linkage mechanism of coal and electricity price, government should establish the price index system of a basket of biomass power materials and the biomass power electricity price should be connected with these indexes [5]. When the price indexes exceed a certain degree, government should adjust electricity price of biomass power generation timely. Second, considering "*externality*" of conventional and biomass power generation, government should levy the reasonable taxes of water discharge or environment on conventional energy generation and compensate for biomass power generation [19]. Third, according to different benchmark electricity prices in different regions, government should provide price subsidies in accordance with same subsidy rates [5].

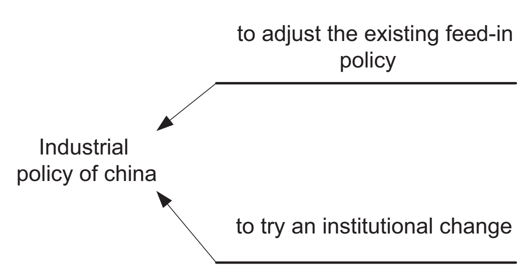


Fig. 4. Main ways to develop the industrial policy of China.

Based on investigation and analysis, we believe that the existing policy framework does not sound, which leads to overheated investment and phenomenon of "*Happy Valley Enclosure*". Without macroeconomic coordination and planning, the power generation industry should have carried on a blind development of biomass power generation technology [2], which succeeded to complete the installed capacity goals but failed to develop the industry sustainably.

3.3.1.1. Incentive policies to complete feed-in tariff is necessary. In order to solve the grid feed-in problem of biomass power generation, grid enterprises should enhance their investment in the network, new transformers, sub-stations, etc. First, on the condition of insisting on supporting power generation project, government will use several methods such as "*the investment exempts from the income tax*", reduction and exemption of tax, incentive tax and compensation. Meanwhile, it provides supports for the investment of power transmission and the cost of operation and maintenance [27]. Second, local government should be given sufficient authorities to solve the problem of grid feed-in in biomass power generation projects. And also local government should support biomass power generation projects within their jurisdiction and provide price subsidy for the investment of power transmission and the cost of operation and maintenance [14].

Moreover, varying financial subsidy standards in accordance with different technologies should be adopted. First, according to different biomass power generation technologies, the relevant department should calculate their costs and set up a set of cost accounting system for biomass power generation [14,24]. The government should fully exert policy guidance function which means that there exists conditional transfer payment and provide different subsidies to enterprises according to the different power generation costs. Second, central government needs to establish the special appropriations for local governments to develop biomass energy industry and provide subsidy policies of high priority to biomass power generation enterprise which has high social benefit but cost much [24]. Third, central government can set target responsibility system for local governments and give them appropriate installed capacity of biomass power generation. In order to encourage enterprises to make full use of the local natural resources and avoid blind investments, the local governments should develop their respective biomass power industries with comparative advantage and provide enterprises the policies to offset income tax and reduce or exempt VAT when they invest the biomass power generation projects [14,25–27].

3.3.2. Establishing a trading system of green certificates

During the "12*th Five-Year Plan*", China will set Renewable Portfolio Standards (RPS) and promote its construction of renewable energy quota trading system. According to the planning of renewable energy sources, biomass power generation industry, besides wind power and solar power generation, will be a key industry in renewable energy development.[2]

Tradable Green Certificate system is a market that makes green certificate trade under the guidance of the price mechanism. Biomass power plants can not only sell the green electricity in Chinese electricity market, but also sell TGC in the green certificate market. So biomass power plants can gain both income from electricity production and the benefits from the sale of green certificates. If the supply and demand of green certificates is balanced in TGC market, the equilibrium price of TGC is inversely proportional to the proportion of renewable energy in the total energy consumption. Adopting the trading system of green certificates means introducing the competition to market [26].

First, by using the membership system, government establishes the regional trading market of green certificates. In the market, the enterprises are allowed to trade the excess capacities of biomass power generation in the form of green certificates after they finish the quota target in order to gain more benefits. With the improvement of the market operation mechanism and the transparency of market information, increasing number of enterprises are allowed to trade in the market to promote the reasonable configuration of money and resources [26,27]. Second, the government perfects the trading market of green certificates, which means that government will use financial derivative products such as forward, options and swaps, etc. to resolve and avoid the risks of price fluctuation by making the reference to the operation mode of financial market. And in order to guarantee the price stability of green certificates to the maximum degree, the government should establish the bank of green certificates to coordinate supply and demand of green certificates at different region in varying periods.

Under the help of market mechanism and industrial policy, biomass power plants become TGC suppliers, while the grid enterprises become TGC demanders. In this case, the system consists of two subsystems: the biomass power industry system and TGC trading system, as can be seen from Fig. 5 that summarizes the biomass power industry development model in TGC system.

4. Conclusions

In summary, here are the following conclusions:

1. China has the ability to achieve the development goal of 30 GW for installed capacity by 2020. The present development goal of 30 GW is not mandatory but directional shows the concern of Chinese government on biomass power generation industry. Theoretically speaking, it is not difficult to achieve such a goal. Currently, the existed policies are adequate to contribute to achieve the development goal of biomass power generation industry. The Chinese government is gradually clearing up the obstacles of the development of biomass power generation.
2. Based on the existed market and policy environment, Chinese government should further to formulate the policy for industrial development. The existed price and subsidy policies still have some problems, the government should accordingly adjust the industrial development policy (the RPS, for example) to change the biomass power industry from "policy-oriented" to "market-oriented". Hence, the upstanding policy framework is an effective tool to guarantee the development of biomass power industry.

We suggest that:

1. The Chinese government should make full use of the Internet, television, newspapers, magazines and other media to make the significance of biomass power generation understood widely. At the same time, plants should focus on technical training and vocational evaluation, perfect the implementation of professional access and licensing system in biomass power generation.
2. Government should effectively promote the construction of tradable green certificates system to help the biomass power generation industry develop well under the combined action of the *visible-hand* and the *invisible-hand*. Also, China should strengthen the market system and policy framework with Chinese characteristics, especially on renewable energy industries.

[2] http://finance.sina.com.cn/roll/20111216/034611003635.shtml

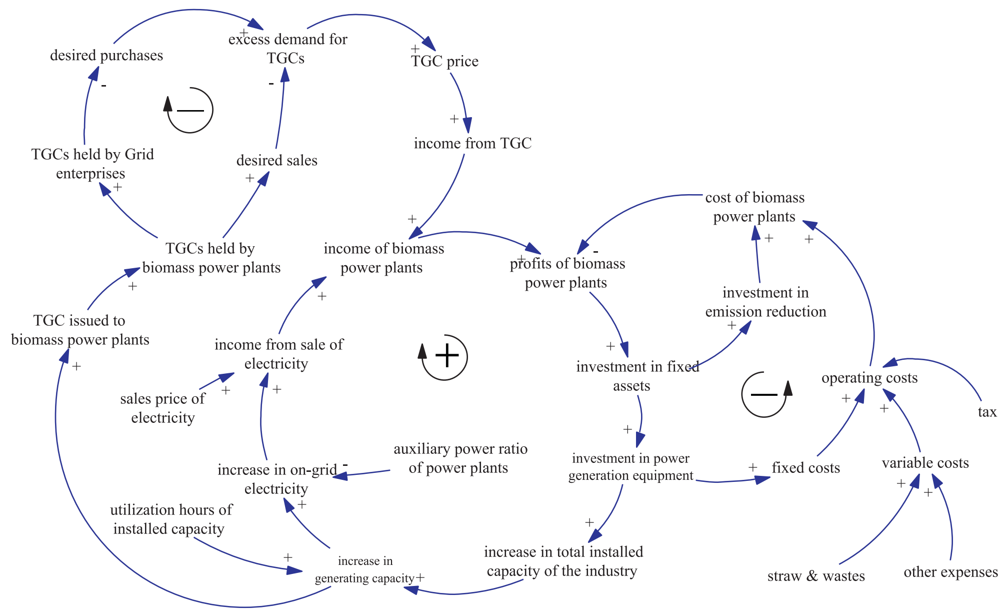


Fig. 5. Feedback loops of biomass power industry with TGC.

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